

NOTES ON THE RIVERS OF SACRAMENTO AND LOWER SAN JOAQUIN WATERSHEDS DURING THE MONTH OF JULY, 1913.

By N. R. TAYLOR, Local Forecaster.

Sacramento watershed.—The rivers in this watershed were generally lower than during any July of which there is a record. In the upper reaches of the Sacramento itself the river averaged slightly above the low water of 1910. From Colusa, however, southward to Walnut Grove the Sacramento averaged from 0.1 of a foot to nearly a foot below all previous low-water stages of which there is a record or a remembrance. At Sacramento City on the 23d the river reached a stage of 4 feet, which is the lowest ever reached in any month of which there is an authentic record.

While there were some heavy rains in the high regions of the Sierra Nevada during the month there was little effect noted in the run-off of the main western feeders or of the trunk stream, the greatest 24-hour rise observed being 0.8 of a foot in the American River.

Tides were common in the Sacramento River during the entire month and were felt for several miles above the mouth of the American. In one instance there was a tide of 1.4 feet in the river at Sacramento City.

Many sand bars have been uncovered during the present low water and, in some cases, channels have changed, making navigation difficult. During the extreme low water the steamer *Empress* struck bottom opposite the city wharf at Sacramento and was unable to reach her berth.

Steamboat men are complaining about the amount of water now being taken out of the river for irrigation purposes, and claim that between 60 and 70 pumps, with capacities ranging from 6 to 12 inch intake, are constantly at work in the Sacramento between the mouth of the American and that of the Feather.

San Joaquin watershed.—The Tuolumne River, while unusually low for the month, averaged about 0.9 of a foot above that of July, 1910. In all other streams the water was the lowest of any July since records have been kept. This was especially so of the Calaveras, which was practically dry during the entire month, and the lower San Joaquin, which averaged between 6 and 7 feet below the July normal and nearly a foot below the previous low water stage, which was in 1910.

FORECASTING THE WATER SUPPLY IN CALIFORNIA.

(From Weather Bureau records of precipitation.)

By Prof. ALEXANDER G. MCADIE.

The writer has in press a somewhat extensive memoir on the "Rainfall of California."¹ From the various records available it appears that no secular periodicity of wet and dry seasons can be found and that excessive rainfalls, also periods of prolonged drought, come and go irregularly. It also appears that there are certain definite relations between excess and deficiency in rainfall and the distribution of atmospheric pressure. Thus the character of a month, and sometimes of a season, is found to bear a direct relation to the position and intensity of certain pressure areas, which for lack of a better name have been called centers of action. This term we believe was originally used by de Bort and has been lately abbreviated by continental writers to action centers. As the term is somewhat awkward and lacks precision, the writer suggests the use of the term hyperbar

for abnormally high seasonal pressure over a given district, and infrabar for a well-marked seasonal depression. The terms pleiobar and meiobar have been suggested by M. A. F. Prestel, but do not seem to be altogether appropriate.

A good illustration of this law of seasonal variation of precipitation and aberration of hyperbars and infrabars is found in the months of January and February, 1902. January, usually a wet month, was abnormally dry, the deficiency in precipitation for California determined by records from nearly 200 stations was approximately 33,000,000 acre-feet. This was a dry winter month and there was every prospect of a shortage of water for the following spring and summer. But what happened? There was a marked change in the position and intensity of the Aleutian low (the infrabar) and also in the location of the continental high (the hyperbar) with the result that February was abnormally wet and even in the short month there was an excess of practically 43,000,000 acre-feet.

The following table gives the approximate precipitation for California in million acre-feet:

	January.	February.	March.	Winter.
1897.....	22	49	33	104
1898.....	9	24	6	39
1899.....	29	4	51	84
1900.....	28	8	19	55
1901.....	42	50	9	101
1902.....	12	68	29	109
1903.....	38	15	48	101
1904.....	12	66	71	149
1905.....	36	35	45	116
1906.....	66	42	77	185
1907.....	63	38	89	190
1908.....	39	36	12	87
1909.....	135	67	28	230
1910.....	40	20	20	80
1911.....	110	29	50	189
1912.....	28	6	43	77
1913.....	42	17	18	77
Mean.....	751 44	574 34	648 38	1,973 116

Attention is called to the winter of 1909, particularly January, when nearly three times the average amount of rain fell. As early as the end of January, notwithstanding floods, excessive runoff, and general waste, it was plain that there would be an abundance of water. Reference to the depth of snow on the ground shows how deep the snow cover was.

The present season (1913) is especially interesting because while January was a month of nearly average water supply, February and March gave only about half the normal precipitation. The amount of water which has fallen as rain is not sufficient for general need and must be supplemented from storage or ground sources.

The depth and extent of the snow cover in the mountains give in a general way a reliable index of the character of the season, the probable water supply, and the river stages. This frozen storage decreases in four ways: First, by melting or run-off; second, by evaporation; third, by percolation or seepage; and fourth, by absorption of forest cover. This water of vegetation in part is reevaporated from the leaf surface by the processes of transpiration; but so far as California is concerned the water is practically lost.

Of these four factors, the second, that is, evaporation, is as effective in dissipating snow as any of the others. There are certain thermodynamic reasons why a current of air in these latitudes moving east from sea level over

¹ To be published by the University of California.